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CABOT CORPORATION, OXIDES DIVISION
TUSCOLA, ILLINOIS

APPLICATION FOR PERMIT TO DISPOSE
OF HYDROCHLORIC ACID IN ST. PETER SAND

815-65

RECEIVED

DEC 13 1965

DIVISION OF SANITARY ENGINEERING
ILLINOIS DEPT. OF PUBLIC HEALTH

EPA Region 5 Records Ctr.



298913

Prepared By:

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Registered Professional Engineer
Texas No. 20276

INDUSTRY

Cabot Corporation has a plant located three (3) miles west of Tuscola, Illinois, manufacturing a finely divided silicon dioxide. This product is sold under the trade name Cab-O-Sil*. This very versatile material is used as a rubber reinforcing agent, an "anti-crawl" additive to plastics, an anti-settling agent in paints, and a flatting agent in varnish, as well as a gelling agent in printing inks. It adds non-sticking qualities to insecticide dusts, insulating qualities to electrical equipment and is a coating for paper. The plant employs some 36 people and is currently being expanded.

The Corporation is also the world's leading carbon black manufacturer and is engaged in oil and gas development and production in the Southwest.

A by-product of the process at the Tuscola Plant is hydrochloric acid. During the next calendar year Cabot will lose their present contract sales of this product. Cabot will attempt, and expects, to sell most of this acid on the open market. However, in the event Cabot is unable to sell all of the acid produced we desire to dispose of any surplus into a suitable subsurface formation. Cabot proposes to do this by drilling and completing a deep disposal well, in a suitable formation, on, or adjacent to, the company's property at Tuscola.

LOCATION

Proposed location for the disposal well is 1745 feet north and 2120 feet west of the southeast corner of Section 31, Township 16 North, Range 8 East of the Prime Meridian, Douglas County, Illinois. Location is in the SE/4 of Section 31 on land owned in fee by Cabot Corporation.

*U.S. Reg. Pat. Off.

VOLUME

Cabot Corporation proposes to dispose of up to 35,000 gallons per day of waste at the current time. It must be realized this amount will be disposed of only in the event Cabot is unable to sell any of the product. The Company believes the well will be used infrequently in emergency circumstances only.

CHARACTERISTICS OF WASTE

Waste to be disposed of is Hydrochloric Acid with a gravity of 20⁰ Baume. There is a trace of suspended solids (silicon dioxide) in the acid. This will not pose a disposal problem.

DISPOSAL FORMATION AND FORMATION WATER

Cabot Corporation is considering use of the St. Peter Sand for disposal. The St. Peter appears to have sufficient porosity and permeability to accept waste fluids at reasonable pressures.

The St. Peter is an Ordovician sandstone expected to be found at a depth of about 3,800 feet. The sand is expected to be some 150 feet thick in this area and is a fine to medium grained white sand. The St. Peter is overlain by approximately 600 feet of dolomites and limestones and some 200 feet of impervious Maquoketa Shale. These formations would prevent the upward migration of fluids from the St. Peter.

Analysis of water for the St. Peter Sand some seven (7) miles northeast of the proposed disposal well indicates the water is not potable. It contains some 10,000 to 12,000 ppm Chlorides and total solids of 19,000 to 22,000 ppm. The water had an odor of H₂S (hydrogen sulphide).

PROPOSED WELL CONSTRUCTION

Attached is a sketch of the proposed well plan. It is Cabot's intention to seal off all fresh water strata with steel casing cemented back to the surface. We anticipate this surface casing to be set at approximately 500 feet.* The well will be drilled through the injection horizon and the injection string of casing cemented in place at the top of the disposal horizon.

The bottom 200 to 300 feet of injection casing will be epoxy fiberglass pipe. Cement used will be common ordinary oil field cement followed by enough phenol-formaldehyde plastic cement to surround the fiberglass pipe.

The injection section will be open hole. Injection will be through 2" epoxy fiberglass tubing set at the bottom of the casing. Annular space between tubing and casing will be filled with diesel oil for corrosion protection of the steel casing.

Instrumentation will be provided to detect leaks in any pipe string immediately. Upon detection of a leak in any string of pipe, injection of waste material will cease and the tubing and casing will be flushed with fresh water before repairs are started.

WELL OPERATION

Based upon available information, we believe injection will be done with a vacuum at the surface on the injection tubing. Normal operation would be for an electrically operated solenoid to open a valve on the acid supply line upon a high level signal from the acid storage tank. This

valve will close automatically upon a low level signal from the acid storage tank.

Because of specific gravity differentials between the acid, formation brine, and oil in the tubing-casing annulus the annulus will always be under a positive pressure at the surface. Pressure sensing instruments on the annulus and tubing will constantly monitor pressures. A variation of pressure exceeding present limits will automatically close in the tubing, thereby stopping injection, and alert the plant operator by means of an alarm system. Plant operator will immediately flush all acid from the well by injecting fresh water down both the tubing and annulus. Sufficient water will be injected to completely clear the tubing of acid and the annulus of diesel oil so that repairs may be made.

In the event pressure is required to inject the acid, the annulus will be isolated from the tubing pressure by means of a packer. This will allow leak detection by means of variations in pressure differentials as before. Flushing will be done as previously stated before repairs are begun.

PUMP PRESSURE

Pressures that will be required to dispose of the waste material are unknown at this time. Cabot believes the disposal will be done under a vacuum. However, in the event pressure is required it will be held as low as possible. In no event would it exceed the parting pressure of the formation (roughly equivalent to 1/2 psi per foot of depth).

DEEP WELLS IN VICINITY

There are several fresh water wells in the vicinity (less than one

mile) of proposed location. These wells are all relatively shallow (less than 200') and will not be subject to contamination.

The nearest oil wells are some two miles southwest of the proposed location. These wells produce from the Spar Mountain Sandstone at a depth of about 1,600 feet and will not be subject to contamination by the proposed disposal system. See Page 12

LOGS OF OTHER WELLS IN THE AREA

Driller's logs of a well drilled by Panhandle Eastern Pipe Line Company in Section 35-T16N-R7E are included. This is the nearest deep well to the proposed location although it did not penetrate the St. Peter formation. Also attached is the driller's log of the Ohio Oil Company's Lewis Shaw No. 1 well in Section 36-T16N-R8E, which penetrated the St. Peter and Mt. Simon. This is the nearest well to penetrate the St. Peter.

APPLICATION FOR DRILLING PERMIT

Attached. See Page 15, 16 & 17

DESIGN PLANS

Attached. See Page 10 & 11

DRILL CUTTINGS AND WATER ANALYSIS

Drill cutting samples and water analyses from formations tested will be submitted to the Illinois State Geological Survey.

SPECIFICATIONS
FOR
HYDROCHLORIC WASTE DISPOSAL INJECTION WELL

GENERAL

The drilling and completion of this waste disposal well shall be done by rotary tools under contract to Cabot Corporation. All operations will be under the supervision of a member of Cabot's engineering staff.

DRILLING

The Driller shall drill a hole from the ground surface to a depth of 200 feet below the bottom of the lowest potable ground water formation, as determined by electric logging during course of drilling. Potable water is defined as that containing no more than 5000 ppm total dissolved solids. It is estimated that the depth of the surface hole will be about 500 feet. The surface hole shall have a diameter of 12-1/4 inches.

After the hole is cased and cemented, the driller shall drill a well hole 7-7/8 inches in diameter, through the overlying strata into and through the St. Peter Sand. It is estimated that the St. Peter Sand will be found at a depth of about 3800 feet and that the bottom of the hole will be at a depth of 3950 feet below the surface of the ground.

All drilling shall be performed by a rotary drill using a mud slurry drilling fluid. The Driller shall keep an accurate log of all essential data during his drilling operations, and shall furnish a daily record of the progress of the work. He shall collect and retain washed, or bailed, samples of the drill cuttings from such cuttings as will be indicated by the geologist. The Driller shall procure from the State Geological Survey, Urbana, a sufficient number of

sacks and identification tags for samples of cuttings, and two driller's log books for the well. All well tailings shall be disposed of on the site as directed by the Engineer. The Driller shall provide a temporary cap for the well during all periods of temporary shutdown of the work.

In the event the Driller fails to sink the well to the depth specified or to a lesser depth, as may be ordered by the Engineer, or should the well be abandoned for any reason, the abandoned hole shall be filled with mud and concrete.

LOGGING

The following logging services are contemplated at this time.

1. For the surface hole:
 - (a) Induction-Electrical log.
 - (b) Formation Density log.

These logs will be used to determine the resistivity of the connate water in the rock formations and will indicate the presence or absence of fresh water.
2. Upon completion of drilling the 7-7/8" diameter well to total depth:
 - (a) Induction-Electrical log.
 - (b) Gamma Ray-Sonic-Caliper log, for showing porous, permeable zones and for determining the hole size for computing the volume of cement required for cementing.

FORMATION TESTING

1. Formation Fluid Sampling - Samples of fluid from the proposed disposal formation will be withdrawn from the proposed disposal formation during completion of the well. Formation fluid samples will be submitted to the Illinois State Geological Survey.

Analyses of the samples shall be submitted to the Illinois State Sanitary Water Board.

2. Drill Stem Testing - Drill stem tests of the St. Peter Sand, and other likely disposal zones drilled, will be taken in order to determine pressures prevalent in each reservoir, rock properties, and to secure formation fluid samples. These tests will be made in open hole before the casing is placed.

CASING

1. Surface Casing - Surface casing shall be 8-5/8" OD; 24 lb. per foot, new seamless steel pipe.
2. Long String Casing - Long string casing shall consist of 300 feet of 4-1/2" OD fiber-glass epoxy heavy duty pipe and approximately 3500 feet of 5-1/2" OD, 15.5 lb. per foot, J-55, new seamless steel pipe. The entire string shall be long enough to reach from the surface to the top of the St. Peter Sand. The bottom of the casing string shall extend some 10 to 25 feet below the top of the St. Peter Sand when installed in the well. The pipe shall have threaded ends and shall be jointed by screwed couplings.

CEMENTING

Cementing, or grouting, of the annular space surrounding each casing string shall be done under pressure with the spaces completely filled, applied from the bottom of the casings and forced up to the ground surface. Cementing shall be in such manner that the entire filling of the annular spaces will be completed.

Surface casing shall be cemented with Class A Portland cement with suitable accelerator. Cement slurry shall be pumped down the casing. Displacement shall be with a wiper plug and mud. The casing shall be centered by centralizers.

Long string (5-1/2") casing shall be cemented for the full length of pipe. Cement shall be Class A Pozmix, salt saturated, with friction reducer and a sufficient amount of formaldehyde-phenol plastic cement to cover the epoxy fiber-glass casing. Cement shall be pumped down the casing string and displaced with a wiper plug and mud. A sufficient number of centralizers shall be used for centering over the entire length of the casing string.

INJECTION TUBING

Disposal shall be through 2" EUE fiber-glass epoxy pipe set approximately at the bottom of the long casing string.

WELL-HEAD STRUCTURE

Upon completion of the well, Cabot will construct a well-head structure as shown on the attached drawing. Said structure shall be of concrete or asphalt surrounded by a ditch one foot deep and two feet wide containing crushed limestone.

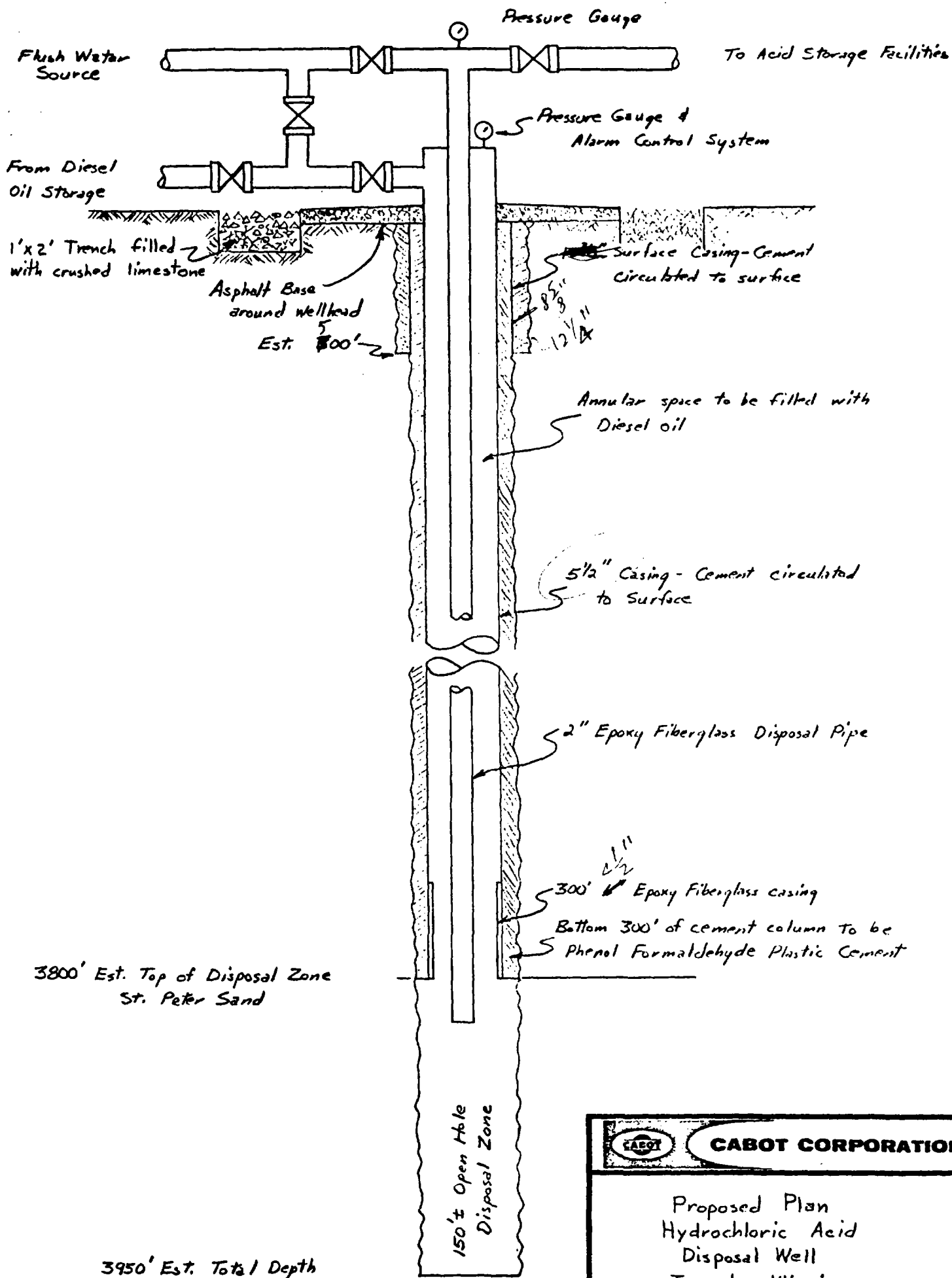
ACID STORAGE

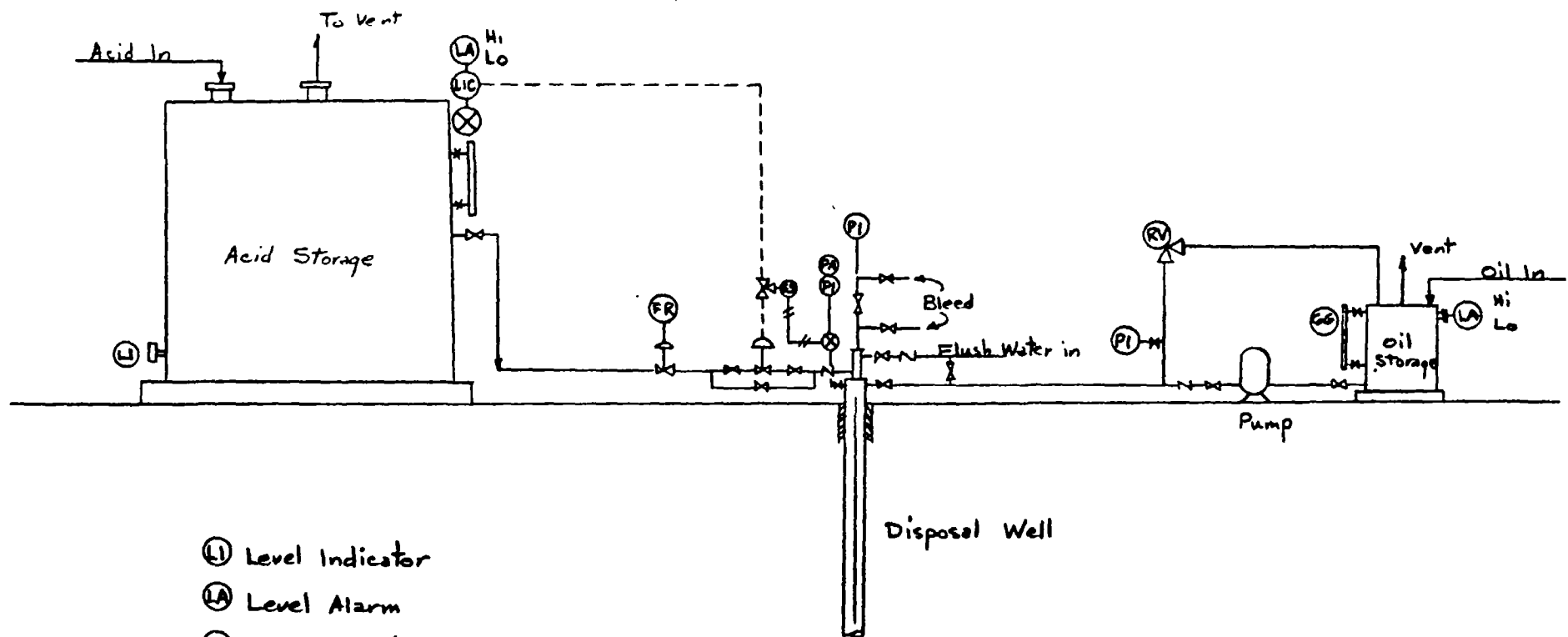
Storage for 380,000 gallons of acid (about 20 days' production) shall be provided at the plant site. Storage shall be in a rubber lined steel tank set upon a concrete base.

TRANSFER PIPING, FITTINGS AND CONTROLS

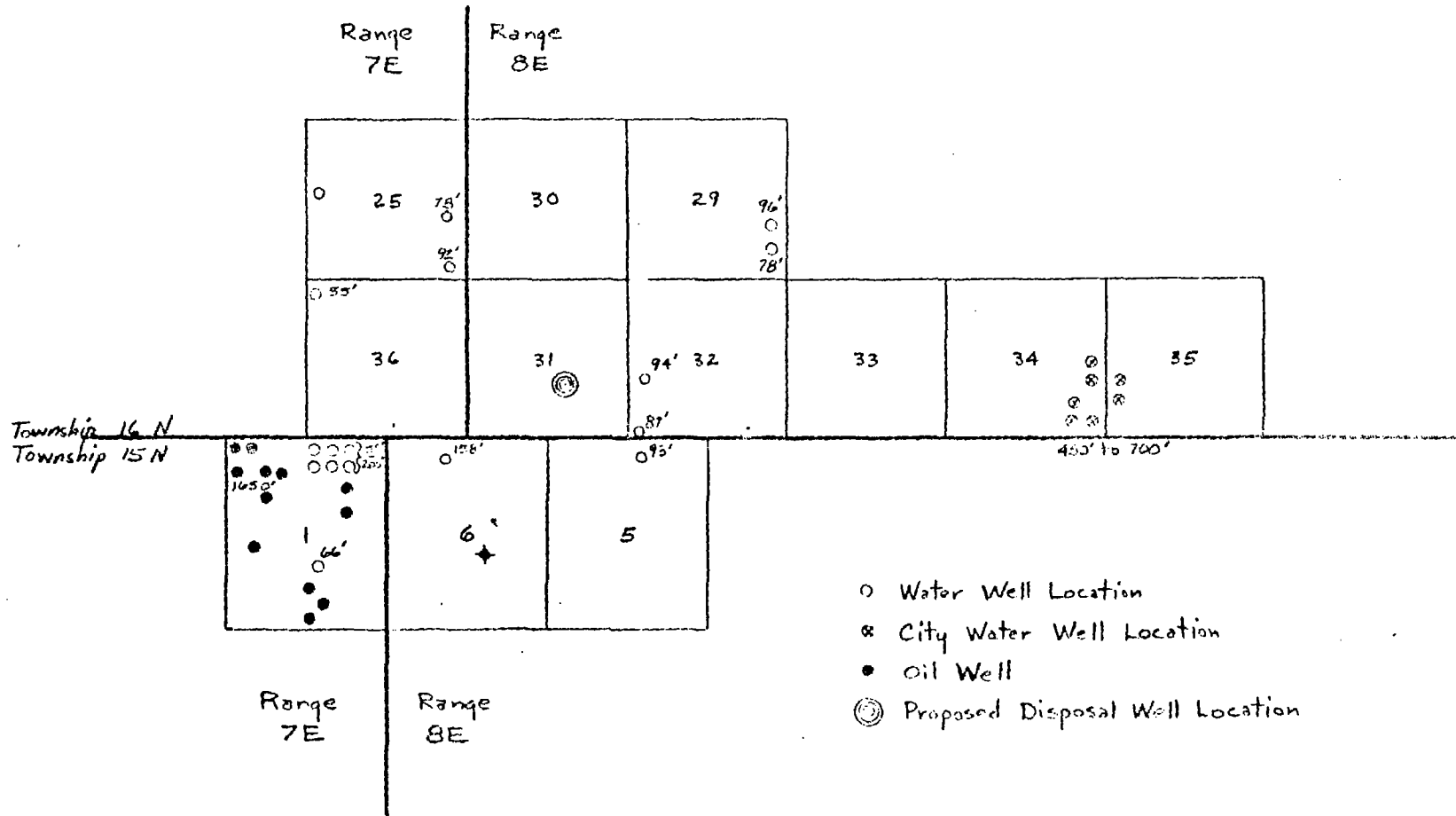
All acid piping shall be either poly-vinyl-chloride plastic pipe or epoxy fiber-glass pipe. Connections and valves shall be of the same material as the pipe where possible. Where necessary metallic equipment will be rubber or plastic lined or coated. All control instruments coming in contact with acid shall be protected by coating with rubber or plastic.

Piping and controls shall be as indicated on the attached drawing.





- LI Level Indicator
- LA Level Alarm
- LIC Level Indicator Controller (High-Low Level)
- PI Pressure Indicator
- PA Pressure Alarm (High.-Low Level)
- ES Electrically Operated Solenoid
- FR Flow Recorder



SECRET

DISPLACEMENT CALCULATIONSST. PETER SANDAssumptions

1. Displacement will be uniformly radial over the entire sand thickness.
2. Porosity of 20%.
3. Connate water saturation of 30%.
4. Reservoir rock saturated with brine initially.

Calculations

Displaceable Volume/Acre Foot

$$V = (7758 \text{ Bbl/Acre Foot})(0.20 \text{ porosity})(1 - 0.30 \text{ displaceable volume})$$

$$= 1,086 \text{ Bbl/ac.ft.}$$

- I. Assume disposal of 20,000 gal/day for 100 years and sand thickness of 50 feet.

$$\text{Volume to be injected} = 20,000 \text{ gal/D} / 42 \text{ gal/bbl} \times 36,500 = 17,380,952 \text{ Bbl.}$$

$$\text{Reservoir Volume Displaced} = 17,380,952 \text{ Bbl} / 1,086 \text{ Bbl/ac.ft.} = 16,000 \text{ ac.ft.}$$

$$\text{Reservoir Areal Acres Displaced} = 16,000 \text{ ac.ft.} / 50 \text{ ft.} = 320 \text{ acres.}$$

$$\text{Radius of Area Displaced} = \left[\frac{(43,560 \text{ sq.ft./acre})(320 \text{ acres})}{3.14156} \right]^{1/2} = 2,106.4 \text{ ft.}$$

- II. Assume disposal of 20,000 gal/day for 100 years and sand thickness of 25 feet.

$$\text{Reservoir Areal Acres Displaced} = 16,000 \text{ ac.ft.} / 25 = 640 \text{ acres.}$$

$$\text{Radius of Area Displaced} = 8,874,063^{1/2} = 2,979 \text{ ft.}$$

- III. Assume disposal of 20,000 gal/day for 100 years and sand thickness of 100 feet.

$$\text{Reservoir Area Displaced} = 16,000 \text{ ac.ft.} / 100 = 160 \text{ acres.}$$

$$\text{Radius of Area Displaced} = 2,218,516^{1/2} = 1,489.5 \text{ ft.}$$

ESTIMATION OF POSSIBLE INJECTION RATE

ST. PETER SAND

Assumption:

Effective injection thickness of sand	100 feet
Radius of well bore, (R_w)	0.33 feet
Permeability (k), darcies	0.1
Viscosity (μ), cp	1
Static Bottom Hole Pressure, (P_e)	1600 psi
Depth to top of St. Peter	3800 feet
Maximum assumed radius of injection, (R_e)	2640 feet
Specific gravity of waste	1.16
Injection with zero pressure at surface	

Bottom hole injection pressure

$$P_w = (0.433 \text{ psi/ft})(1.16)(3800 \text{ feet}) = 1910 \text{ psi}$$

Injection Rate

$$\begin{aligned}
 Q &= (7.07)(k)(h) \left[\frac{P_e - P_w}{\mu \ln R_e/R_w} \right] \\
 &= (7.07)(0.1)(100) \left[\frac{1600 - 1910}{1 \ln (2640/0.33)} \right] \\
 &= \underline{2,443 \text{ bbl/day}} \text{ or } \underline{71.2 \text{ GPM}}
 \end{aligned}$$

070962-5,000

STATE OF ILLINOIS
Sanitary Water Board
Springfield, Illinois

Fill In All Blanks

APPLICATION FOR PERMIT FOR CONSTRUCTION, INSTALLATION, MODIFICATION OR OPERATION OF SEWAGE WORKS OR ANY EXTENSION OR ADDITION

LOCATION OF PROJECT Douglas
(County) (Municipality, etc.)

THE Cabot Corporation Tuscola, Illinois
(Legal Name of Applicant) (Address)

HEREBY MAKES APPLICATION TO THE SANITARY WATER BOARD OF THE STATE OF ILLINOIS FOR THE ISSUANCE OF A PERMIT TO INSTALL Deep well hydrochloric acid disposal facilities at Cabot's Cab-O-Sil plant 3 miles west of Tuscola, Illinois
(Describe briefly the sewage works for which application is made)

AND Cabot Corporation, Tuscola, Illinois TO OPERATE
(Municipality, Corporation, Address)

WITH OUTLET TO St. Peter Sandstone at an approximate depth of 3800' below ground surface
(Identify point of connection or discharge)

AS MORE FULLY SHOWN ON ACCOMPANYING PLANS AND SPECIFICATIONS PREPARED BY William F. Blank 20592
(Name of Engineer) (Illinois Registration No.)

ACTING AS MY AGENT (DELETE IF NOT APPLICABLE) W. M. [Signature] Texas Registration No. 20276

SAID PLANS CONSISTING OF 24 SHEETS AND ENTITLED Application for Permit to Dispose of Hydrochloric Acid in St. Peter Sand BEING MADE A PART HEREOF.

PROJECT APPROVAL

1. Sewer Lines: By indicating their approval hereon the signers hereby attest that they have ascertained that the proposed installation will be adequate for all sewage flow from sanitary sewer lines to be made tributary to the proposed installation; that the existing sewer lines and the sewage treatment works have adequate capacity for the additional sewage flow from the proposed installation; and furthermore, that the installation shall be made under the supervision of an inspector provided by or approved by the consulting engineer.

2. Sewage Treatment Works: By indicating their approval hereon the signers hereby attest that the proposed treatment works or proposed treatment works additions will be operated or supervised by a duly qualified sewage works operator as Certified under Regulations of the Sanitary Water Board.

FOR CONSTRUCTION APPROVAL

(Signature of Applicant or Agent)

DATE

12/1/65

Vice President - Cabot Corporation
Title: Owner, Installer, or Agent

FOR OPERATION APPROVAL

(Signature of Mayor, President, etc.)

DATE

12/1/65

Vice President - Cabot Corporation
(Title)

ATTESTED

(Date)

(Signature)

(Clerk)

FOR SPECIAL CONCURRENCE OR APPROVAL (SANITARY DISTRICTS WHERE REQUIRED LOCALLY, ETC.)

DATE

(Signature of President, etc.)

(Title)

ATTESTED

(Date)

(Signature)

(Clerk)

The application shall be signed as follows:

- For construction within the limits of a municipality, the application shall be signed by the installer and by a municipal official, and attested by the clerk. If municipally owned, the municipal official will sign as the owner regardless of location.
- If the proposed facilities are privately owned and located outside a municipality, the owner or responsible officer of the organization shall sign the application and obtain signature of a proper official of the agency responsible for operating the installation.

NOTE

- "Sewage Works" means individually or collectively those constructions or devices used for collecting, pumping, treating, and disposing of sewage, industrial waste or other wastes, (or for the recovery of by-products from such sewage, industrial waste or other wastes.)
- "Municipality" means Sanitary District and/or similar governing agencies.

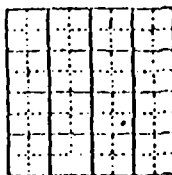
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ILLINOIS GEOLOGICAL SURVEY, URBANA

Page 1

Strata	Thickness	Top	Bottom
Drift		0	90
Pennsylvanian			
Shale, gray		90	110
Lime		110	120
Shale, red and green		120	160
Shale, limy		160	170
Lime, brown		170	180
Sample description			
Sandstone, light gray, fine, limy		180	183
Sandstone, light gray, fine slightly micaceous		183	245
Sandstone, above; a little black platy shale		245	255
Shale, gray, soft		255	280
Shale, gray, soft; some black shale; trace of lime		280	319
Millersburg:			
limestone, white, dense		319	348
Limestone, tan, sandy		348	355
Shale, dark gray micaceous		355	385
Sandstone, light gray, fine, limy		385	400
Shale, greenish-gray and reddish-gray		400	450
Shale, black platy; a little limestone, light brown		450	465
Shale, gray soft, micaceous, sandy		465	480
Sandstone, white, medium fine, sub-angular		480	505
Shale, gray, limy		505	510
Sandstone, white, well cemented angular		510	520
Limestone, tan to light brown, dense		520	550
Limestone, above; some shale, gray		550	580
Shale, gray, trace of limes		580	620
Shale, black and gray; some limestone, tan		620	635
Limestone, tan, somewhat cherty		635	645
Shale, gray limy		645	660

COMPANY Panhandle Eastern Pipeline Co.
 FARM Phillips NO. 1
 DATE DRILLED August 1957 COUNTY NO. 439
 AUTHORITY D. W. Straight
 ELEVATION 675' KB - Company
 LOCATION 300'S line, 300'E line of NE SE
 COUNTY DEUEL



35-164-73

Strata	Thickness	Top	Bottom
Shale, gray, soft, muddy		660	740
Shale, black; shale, gray; sandstone, white; trace of coal		740	750
Limestone, tan to gray		750	770
Sandstone, light gray, fine, somewhat limy		770	870
Limestone, buff, dense		870	880
Shale, black		880	890
Shale, light gray, sandy and limy		890	950
Shale, black; limestone, tan; trace of coal		950	970
Shale, gray, limy		970	980
Limestone, tan to gray; shale, black; trace of coal		980	990
Shale, gray; a little limestone, buff		990	1010
Shale, gray and dark gray; limestone, tan		1010	1020
Shale, gray; a little limestone, tan		1020	1030
Shale, black; a little limestone, tan		1030	1091
Limestone, white to light brown, hard somewhat sandy		1091	1103
Shale, black		1103	1120
Shale, gray to dark gray; somewhat limy and sandy		1120	1253
<u>MISSISSIPPIAN - Chester</u>			
<u>Barlow</u>			
Limestone, white to light brown, cherty trace of sand		1253	1276
Limestone, tan, dense, trace of sand; some shale, dark gray		1276	1290
<u>Cypress</u>			
Sandstone, white, fine, limy and shaly		1290	1332
<u>Paint Creek</u>			
Limestone, white to tan, dense; shale, greenish gray and some red		1332	1340
Shale, greenish-gray and red; some limestone, tan		1340	1360
<u>Seneca</u>			
Sandstone, light gray, very fine, limy		1360	1363
Shale, gray; some limestone, tan		1363	1373

Pechullo Eastern Pipeline Co.

Phillips #1

39-161-73

COUNTY DOUGLAS

Strata	Thickness	Top	Bottom
Shale, greenish-gray and red; some limestone tan		1373	1413
<u>Renault</u>			
Limestone, brown, dense		1413	1420
Shale, greenish-gray, platy; some red shale; trace of limestone		1420	1430
Limestone, brown dense		1430	1433
<u>Aux Vases</u>			
Limestone, brown, dense; some sandstone, light gray, shaly		1435	1440
Shale, red and green; some sandstone, light gray, fine		1440	1448
<u>St. Genevieve-Levias</u>			
Dolomite, white, very fine crystalline; slight porosity, oil stain and fluorescence 1455-61		1448	1470
Limestone, brown, dense		1470	1483
Limestone, tan, very fine crystalline, cherty		1483	1503
Limestone, tan <u>oolitic</u>		1503	1520
<u>Basilar</u>			
Limestone, light gray to light brown, dense to slightly oolitic		1520	1541
Limestone, brown dense, slightly oolitic		1541	1570
Limestone, light gray, very fine crystalline, somewhat cherty; trace of gypsum		1570	1601
<u>Salina</u>			
Limestone, light brown, dense		1601	1610
Limestone, light tan to brown fine crystalline fossiliferous, no fluorescence (Microlog porosity 1614-18'; 1624-26)		1610	1630
Limestone, light gray to white, fine crystalline; trace of chert		1630	1640
Limestone, gray, dense, argillaceous		1640	1643
Limestone, gray; chert, tan to gray		1643	1650
Shale, gray, limy		1650	1660
Limestone, gray, dense to finely crystalline		1660	1690
Shale, gray, limy		1690	1720
Shale, gray, silty to sandy; trace of red shale		1720	1773

Pechullo Eastern Pipeline Co.

Phillips #1

COUNTY DOUGLAS

39-161-73

Strata	Thickness	Top	Bottom
Shale, as above; some limestone, white		1775	1820
Shale, gray, silty, to sandy; trace of red shale		1820	1890
Shale, gray-green and red, silty; trace limestone, tan		1890	1910
Shale, gray, limy and somewhat sandy		1910	1973
Shale, green-gray to gray; a little limestone, white to pink		1973	1980
Shale, gray, silty and sandy; a little red shale		1980	2005
Limestone, gray, shaly; a little sandstone, fine		2005	2015
Shale, gray-green silty; some limestone, tan		2015	2070
Sandstone, gray, shaly		2070	2115
Shale, gray, sandy		2115	2195
Shale, gray, sandy; a little shale gray-green and black		2195	2220
Sandstone, light gray, fine, silty		2220	2234
Shale, gray-green and black		2234	2240
Sandstone, light gray, fine silty		2240	2250
Shale, gray-green and black; a little red shale		2250	2295
Dolomite, light gray, very fine crystalline		2295	2302
Shale, gray-green and gray; some limestone, tan		2302	2322
<u>NEW ALBAN Y.</u>			
Shale, black and green		2322	2364
Shale, gray; a little limestone, tan		2364	2380
Limestone, light brown to tan, dense shaly		2380	2402
<u>DEVONIAN</u>			
Dolomite, tan to brown, crystalline; chert white		2402	2435
Limestone, tan to brown, finely crystalline		2435	2445
Limestone, white finely crystalline; a little chert		2445	2460
Limestone, tan, finely crystalline, imbedded sand grains		2460	2465
Dolomite, white with scattered sand grained		2465	2500

Strata	Thickness	Top	Bottom
Dry and abandoned. Plugged August 22, 1957			
Casings 7" - 179' with 135 sacks cement.			
S.S.#30460			
Electric log filed			
Microlog filed			
Driller's log filed			
Time log filed.			

ILLINOIS GEOLOGICAL SURVEY, URBANA

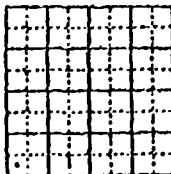
ILLINOIS GEOLOGICAL SURVEY, URBANA

Strata	Thickness	Top	Bottom
Cable Tools Studied by E. P. Dubois, 1944. No samples	40		40
EVONIAN SYSTEM			
Limestone, buff, silty, fine to very fine, slightly petroliferous.	5		45
Limestone, buff, white, medium to coarse, crystalline, very fossiliferous.	5		50
Dolomite, silty, brown, fine, granular, petroliferous, porous.	10		60
Dolomite, silty, brown; gray, very fine, granular, partly sandy.	13		73
Dolomite, partly sandy, gray, brown, extra fine, partly petroliferous.	7		80
Same, but very dense, more sandy.	15		95
Dolomite, silty to sandy, gray, buff, extra fine.	35		130
Same, to sandstone, dolomitic, buff, gray, fine, medium (last 5 feet).	15		145
SILURIAN SYSTEM			
Niagaran Series			
Dolomite, gray, fine, medium, crystalline.	20		165
Same, sandy, cherty.	10		175
Dolomite, cherty, brown, buff, very fine.	35		210
Dolomite, cherty, gray, buff, very fine.	40		250
Dolomite, brown, very fine, petroliferous.	35		285
Dolomite, white, brown, fine, very fine, slightly petroliferous.	20		305

Strata	Thickness	Top	Bottom
Dolomite, white to gray, very fine, dense.	70		375
Dolomite, argillaceous, greenish, gray, very fine.	15		390
Dolomite, argillaceous, silty, grayish-green, very fine, granular, little dolomite, gray, fine, dense.	35		425
Siltstone, very dolomitic, green.	20		445
Dolomite, white to gray, fine, oil stained, cherty.	10		455
Dolomite, very silty, grayish-green, very fine, granular, cherty, little siltstone, green.	100		555
Limestone, part very silty, dolomitic, green, little pink, buff, very fine.	25		580
Same: shale, calcareous, reddish-brown.	10		590
Limestone, argillaceous, silty, weak, pink, red, green, very fine, medium.	30		620
Limestone, light buff, red fossil casts, lithographic.	25		645
Same, partly argillaceous, greenish, pinkish.	25		670
Limestone, buff, pink casts, very fine, very coarse.	35		705
Alexandrian Series			
Limestone, partly argillaceous, partly glauconitic, brown, white, very fine, pyritic, very finely sandy.	10		715
Same, and brown.	10		725
ORDOVICIAN SYSTEM			
Maquoketa Formation			
Siltstone and shale, calcareous, green.	15		740
Shale, silty, tough, green; siltstone, argillaceous, green, tough (interbedded).	55		795
Shale, as above; limestone, argillaceous, brown, mottled, fossiliferous.	27		822

COMPANY The Ohio Oil Company
 FARM Shaw, Lewis
 DATE DRILLED January 1945
 AUTHORITY E. P. Dubois
 ELEVATION 666' Grd.-Co.
 LOCATION 330' S line, 330' W line, of Sec.
 COUNTY Douglas S.S.#11355

NO. 1
 COUNTY NO. 799



36-16N-8E

The Ohio Oil Company
 COUNTY Douglas S.S.#11355

Shaw, Lewis #1
 36-16N-8E

Strata	Thickness	Top	Bottom
Limestone, mottled, white, black, coarse, fossiliferous.	8		830
Shale, very calcareous, brownish-green; limestone, very argillaceous, brownish-green.	20		850
Shale, calcareous, gray, very fossiliferous; some limestone, fossiliferous, brown.	25		875
Shale, calcareous, gray, some brownish-gray.	72		947
Kilmswick limestone			
Limestone, buff to brown, very fine, fossiliferous.	6		953
Limestone, buff, very fine, some fine, medium; some clay partings.	42		995
Same, fossiliferous; little flour at 1010'.	35		1030
Limestone, buff, brown, medium, fossiliferous.	66		1096
Limestone, brown, extra fine; brown, shaley partings.	4		1100
Plattin limestone			
Limestone, argillaceous, gray, extra fine, fossiliferous; shale, grayish-green.	7		1107
Limestone, brown; gray, lithographic; shale, gray.	11		1118
Limestone, brown, lithographic, very fine, metamorphosed.	8		1126
Limestone, buff, very fine, fine, partly conglomeratic.	34		1160
Limestone, partly argillaceous, brown, gray, lithographic, fine; brown partings.	5		1165
Limestone, buff, lithographic, to fine; brown partings.	10		1175
Same, some gray, partly dolomitic.	10		1185
Limestone, dolomitic, brown, gray,			

Strata	Thickness	Top	Bottom
lithographic, fine.	15		1200
Dolomite, brown, buff, very fine, fine, partly earthy; limestone, as above.	16		1216
Limestone, gray, lithographic to very fine.	9		1225
Same, and brown.	8		1233
Limestone and dolomite, buff, lithographic, very fine; shale, brown.	42		1275
Limestone and dolomite, as above.	45		1320
Dolomite, buff, brown, fine, very fine.	25		1345
Same; limestone, buff, lithographic.	55		1400
Limestone, gray, fossiliferous, fine; shale, gray, red streaks; limestone, brown, lithographic.	16		1416
Limestone and dolomite, brown, little gray; partly argillaceous, conglomeratic, very fine.	9		1425
Dolomite, brown, very fine.	12		1437
Same; limestone, brown, lithographic.	8		1445
Dolomite, as above.	20		1465
Dolomite, partly argillaceous, brown, green, very fine.	10		1475
Joachim-Dutchtown Formations			
Dolomite, buff, earthy, very fine; shale, calcareous, black, brown.	10		1485
Dolomite, argillaceous, laminated, buff, gray, green, very fine, earthy; shale, green; scattered sand.	50		1535
Dolomite, sandy, buff, brown, gray, fine to very fine; sandstone, dolomitic, white, fine.	8		1543
St. Peter Sandstone			
Sandstone, dolomitic, white, gray, fine; some argillaceous.	12		1555
Sandstone, dolomitic, white, fine, very fine.	15		1570
Sandstone, argillaceous, dolomitic,			

Strata	Thickness	Top	Bottom
quartzitic, gray; shale, dolomitic, dark brown, petroliferous.	20		1590
Sandstone, dolomitic, white, fine to medium, pyritic; probably shale and dolomite partings.	20		1610
Sandstone, white, fine to medium, pyritic, in part.	75		1685
Same; shale, green; dolomite, brown, fine.	10		1695
Shakopee Dolomite			
Dolomite, cherty, white, very fine; shale, green.	10		1705
Dolomite, cherty, grayish-buff, very fine; sandstone, dolomitic, buff; shale, green.	9		1714
Dolomite, grayish-buff, very fine, cherty. 21			1735
Same, chert, oolitic, white; chert, white; sandstone, siliceous, white, medium.	10		1745
Dolomite, cherty, buff, very fine; sandstone, dolomitic, white, fine; shale, green.	10		1755
Dolomite, as above; some oolitic chert; green shale; sand.	20		1775
Dolomite, as above; sandstone, dolomitic, and siliceous; green shale, sand shale, gray and green, at 1810'.	40		1815
Sandstone, siliceous, dolomitic, white, buff, medium; dolomite as above.	13		1828
Dolomite, buff, gray, very fine; oolitic chert; little sandstone.	27		1855
Chert, oolitic, brown, green; dolomite, as above.	5		1860
Dolomite, sandstone and shale.	33		1893
Mostly dolomite, some chert (sandstone) and shale as above.	72		1965
Dolomite, white, very fine, slightly cherty; scattered sand.	12		1977

Strata	Thickness	Top	Bottom
Dolomite, slightly sandy, cherty, gray, very fine to fine; shale, green.	4		1981
Dolomite, fine, sandy, white to buff, fine, very fine; shale, green.	9		1990
Dolomite, sandy, grayish-buff, greenish, very fine to fine; oolitic chert.	10		2000
Dolomite, buff, light gray, cherty, fine; sandstone, dolomitic, gray, brown.	10		2010
Dolomite, as above; oolitic chert, white.	10		2020
Dolomite, cherty, gray, very fine; little sand.	5		2025
Same, dolomite, gray, medium; sandstone, dolomitic, gray.	11		2036
New Richmond Formation			
Sandstone, dolomitic, siliceous, white, medium; oolitic chert; dolomite, as above.	34		2070
Oneota Dolomite			
Chert, dolomitic, oolitic, brown; dolomite, brown, fine; sandstone as above.	15		2085
Dolomite, brown, fine; chert, partly oolitic, white to brown; shale, green.	11		2096
Sand and sandy	4		2100
Dolomite, very cherty, brown, fine to medium, scattered sand.	20		2120
Dolomite, sandy, light gray to buff, fine, cherty.	13		2133
Dolomite, sandy, white, fine, medium; some chert.	17		2150
Same, more cherty, buff.	15		2165
Dolomite, cherty, buff, fine.	15		2180
Dolomite, cherty, white, fine; oolitic chert, white.	10		2190
Same, but gray, sandy.	10		2200

Strata	Thickness	Top	Bottom
Dolomite, cherty, sandy, very light buff, fine, medium.	14		2214
Dolomite, slightly sandy, gray, fine.	6		2220
Same, very cherty.	16		2236
Dolomite, cherty, sandy, gray, medium.	24		2260
Dolomite, sandy, gray, medium.	11		2271
Dolomite, white, fine to medium; chert, white, oolitic in part.	44		2315
Dolomite, very cherty, white to light gray, medium.	93		2408
Dolomite, cherty, gray, medium.	17		2425
Same, some brown, cherty oolites.	17		2442
Dolomite, cherty, gray, medium, drusy quartz, green quartz.	8		2450
Dolomite, cherty, gray, medium.	5		2455
Dolomite, cherty, grayish-brown, medium.	20		2475
Dolomite, cherty, gray, medium; oolitic chert.	6		2481
Dolomite, cherty, sandy, gray; chert, drusy quartz; scattered sand.	14		2495
Dolomite, cherty, sandy, gray, fine, medium.	17		2512
Dolomite, white, fine; oolitic chert; drusy quartz.	10		2522
Dolomite, fine to medium, sandy, white, fine; scattered cherty oolites.	48		2570
Dolomite, argillaceous, gray to brown, fine, medium; oolitic chert.	15		2585
Dolomite, gray, brown, medium; much oolitic chert.	10		2595
Dolomite, brown, fine; much oolitic chert, brown.	20		2615
Same and sand, fine to medium.	9		2624
Dolomite, argillaceous, brownish-gray; free sand; sandstone, argillaceous, green, fine; oolitic.	11		2635
Dolomite, fine to very fine, sandy, gray, fine to medium; scattered chert			

Strata	Thickness	Top	Bottom
oolites.	20		2655
Dolomite, gray, fine, very fine; white chalky chert and cherty oolites.	10		2665
Dolomite, brownish-gray, fine; cherty oolites.	15		2680
Dolomite, fine to medium, sandy, gray, partly argillaceous.	5		2685
Sandstone, dolomitic, gray, fine to medium.	10		2695
CAMBRIAN SYSTEM:			
Trempealeau Dolomite			
Dolomite, fine, sandy, gray, fine.	45		2740
Same, not sandy.	20		2760
Dolomite, brown, gray, fine to medium.	15		2775
Same; and drusy quartz.	40		2815
Dolomite, brown, fine; drusy quartz.	50		2865
Dolomite, light brownish-gray; drusy quartz.	10		2875
Dolomite, brown, medium, drusy quartz, glauconitic flecks.	80		2955
Dolomite, slightly glauconitic, mottled, gray to brown, fine to medium.	35		2990
Dolomite, white, tinged brown, green, slightly glauconitic, medium.	10		3000
Dolomite, mottled, brown, gray, medium, oolitic (?).	8		3008
Same, some sandy, all glauconitic.	12		3020
Dolomite, sandy, glauconitic, brown to gray, fine to medium.	15		3035
Same, with brown shale partings.	18		3053
Dolomite, slightly glauconitic, oolitic, mottled, brown, gray, fine, very fine.	4		3057
Dolomite, brown, fine to medium.	13		3070
Same, and white.	10		3080
Dolomite, brown, fine, scattered very fine glauconite.	105		3185

Strata	Thickness	Top	Bottom
Same, partly oolitic; some shale streaks.	30		3215
Dolomite, slightly glauconitic, buff, fine.	10		3225
<u>Franconia Formation</u>			
Dolomite, silty, sandy, fine, glauconitic, gray, green, very fine, fine.	15		3240
Same, little pink.	10		3250
Same; shale, green, firm.	5		3255
Sandstone, dolomitic, glauconitic, gray, green, fine, medium.	10		3265
<u>Galesville sandstone</u>			
Sandstone, dolomitic, slightly glauconitic, white, fine.	20		3285
<u>Eau Claire Formation</u>			
Dolomite, sandy, partly argillaceous, gray to dark gray.	5		3290
Dolomite, argillaceous, partly glauconitic, dark brown, dark gray, sandy at top.	45		3335
Sandstone, dolomitic, gray, brown, fine to medium.	15		3350
Dolomite, very sandy, dark brown, gray, fine to medium.	15		3365
Dolomite, argillaceous, brown, fine; shale, slightly glauconitic, green.	5		3370
Dolomite, as above, but glauconitic; shale, gray, green, brown.	20		3390
Shale, dolomitic, brown; dolomite, as above.	5		3395
Limestone, dolomitic, silty, buff, medium to coarse, glauconitic; siltstone, gray.	5		3400
Shale, green, firm; scattered dolomite.	12		3412
Same; limestone, oolitic, brown, gray, fine, calcareous.	8		3420
No sample	8		3428
Limestone, dolomitic, oolitic, brown			

Strata	Thickness	Top	Bottom
white, fine, very fine, sandy.	22		3450
Limestone, dolomitic, oolitic, buff, fine, granular, porous, very finely sandy.	15		3465
Limestone, dolomitic, oolitic, brown, buff, white, fine to very fine, sandy.	95		3560
Siltstone, glauconitic, micaceous, green, pink; oolitic limestone, as above.	30		3590
Siltstone; shale, micaceous, red, pink, brown, very tough.	10		3600
Siltstone, micaceous, pink; oolitic limestone.	10		3610
Siltstone, micaceous, pink, green.	25		3635
Siltstone, micaceous, pink; scattered oolites.	15		3650
Siltstone, micaceous, pink, little green; scattered red shale and oolitic limestone.	80		3730
Shale, red; siltstone, pink; oolitic limestone; siltstone, green.	15		3745
Siltstone, micaceous, pink; shale, red.	17		3762
Same, and oolitic, pink and brown dolomite; siltstone, green.	12		3774
Siltstone, pink, green; shale, red; dolomite, pink.	11		3785
Siltstone, pink; shale, red, little green.	27		3812
Shale, red, green, glauconitic; siltstone, pink, gray.	58		3870
Shale, siltstone, buff, brown, reddish dolomitic.	35		3905
Shale, sandy, micaceous, green.	5		3910
Same; dolomite, glauconitic; shale, gray, brown, sandy, micaceous.	10		3920
Shale, green, sandy, micaceous, part glauconitic.	20		3940
Shale, green and red, micaceous.	20		3960

Strata	Thickness	Top	Bottom
Dolomite, white, very finely crystalline; shale, dark gray; green, dark red, micaceous.	10		3970
Shale, dark green and dark red, micaceous.	2		3972
Same, and siltstone, dolomitic, gray, glauconitic.	13		3985
Same, mostly shale.	20		4005
Shale, dark gray and red.	5		4010
Shale, dark gray and red, silty; siltstone, pink, glauconitic.	10		4020
Shale; dolomite, silty to sandy, glauconitic, gray; siltstone.	10		4030
Gap	10		4040
Shale	5		4045
Mt. Simon Formation			
Sandstone, pyritic, quartzitic, fine to medium, micaceous.	1		4046
Sandstone, very fine, quartzitic.	11		4057
Sandstone, very fine to medium, loose to compact.	7		4064
Sandstone, pink, very fine to coarse, part quartzitic.	6		4070
Sandstone, white, fine, incoherent.	26		4096
Sandstone, white, fine to coarse, incoherent.	9		4105
Sandstone, white, very fine to medium, incoherent.	35		4140
Sandstone, white, fine to coarse, incoherent.	5		4145
Total depth, driller's log			
Plugged back to			165
Dray and abandoned. Plugged to 165'		January 18, 1945.	
Left as water well at 165'			
No electric log run.			
No drilling time log kept.			

Sample No. _____
Request No. 2186
Project No. _____

STATE GEOLOGICAL SURVEY
URBANA, ILLINOIS
REPORT OF BRINE ANALYSIS

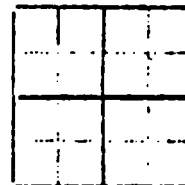
Lab. No. B-1765
County Dauphin
Index No. _____

Analysis requested by W. F. Meente

Sample of Brine From M M M
Section 26 Top 16N Range 4E

Ill. Power Co. and sent to

Collected by W. F. Meente Date 4-12-62
Company Ill. Power Co. Pool Tuscola Gas Storage Area
Farm W. H. Waltrip No. 1 Sur. elev. _____



1. Formation Sand - St. Peter
2. Producing zone depth 1594-1734 Depth well drilled 1744 Present depth 1744
3. Casing: 5 1/2 inch to 1594 feet.
4. Perforation: No. of shots _____ from _____ to _____
5. Acid: Gallons _____ from _____ to _____ Date _____
6. Initial production: Barrels oil _____ Barrels water _____
7. Present production: Barrels oil _____ Barrels water _____
8. Place where sample was obtained Synab sample
9. Date of completion of well _____
10. Properties of reaction in percent:
Primary salinity _____ Primary alkalinity _____
Secondary salinity _____ Secondary alkalinity _____
r SO₄ in (r SO₄ + r Cl) _____; (r CO₃ + r HCO₃) r SO₄ _____

11. Constituents

	Ppm.
NH ₄	_____
Na	_____
K	_____
Ca	_____
Mg	_____
SiO ₂	_____
Non-vol.	_____
Fe	_____
Al ₂ O ₃	_____
Mn	_____
SO ₄	_____
Cl	<u>12,090</u>
NO ₃	_____
CO ₃	_____
HCO ₃	_____
Free CO ₂	_____
H ₂ S	_____
Fe ₂ O ₃ (unfiltered)	_____
Total solids	<u>22,706</u>

12. Reacting values

	Ppm.	%
Alkalies:		
r Na	_____	_____
r K	_____	_____
r NH ₄	_____	_____
Alk. earths:		
r Ca	_____	_____
r Mg	_____	_____
Total	_____	_____
Strong acids:		
r SO ₄	_____	_____
r Cl	_____	_____
r NO ₃	_____	_____
Weak acids:		
r CO ₃	_____	_____
r HCO ₃	_____	_____
Total	_____	_____

13. Hypothes. combination

	Ppm.
KNO ₃	_____
KCl	_____
K ₂ SO ₄	_____
K ₂ CO ₃	_____
NaNO ₃	_____
NaCl	_____
Na ₂ SO ₄	_____
Na ₂ CO ₃	_____
NH ₄ NO ₃	_____
NH ₄ Cl	_____
(NH ₄) ₂ SO ₄	_____
(NH ₄) ₂ CO ₃	_____
Mg(NO ₃) ₂	_____
MgCl ₂	_____
MgSO ₄	_____
MgCO ₃	_____
CaCl ₂	_____
CaSO ₄	_____
CaCO ₃	_____
SiO ₂	_____
Fe ₂ O ₃	_____
Al ₂ O ₃	_____
MnO	_____
Non-vol.	_____
Total	_____

15. Condition of sample:

(a) Color Colorless
(b) Odor Strong H₂S

(c) Turbidity Black Sediment
(d) Oil present? No
(e) Necessary to filter? Yes
(f) Container 1 Gal. glass jar

Date of report May 2, 1962

O. W. Rees, By RCL

Analytical Division.

Sample No. 1 B-1756
Request No. 9090
Project No. _____

STATE GEOLOGICAL SURVEY
URBANA, ILLINOIS
REPORT OF BRINE ANALYSIS

Lab. No. B-1756
County Champaign
Index No. _____

Analysis requested by W.F. Meents
Ill. Power Co. #1, Arnold Koss 497'S 159'E, NW corner NE, SE, Champaign Co. Ill.

Sample of Brine From 1/4 1/4 1/4 1/4
Section 21 Twp. 17 N Range 8 E

Collected by W. F. Meents Date 1-11-62 at well
Company Ill. Power Co. Pool Tuscola Gas Storage Area
Farm Arnold Koss No. 1 Sur. elev. _____



1. Formation Sand - St. Peter
2. Producing zone depth 1640-1795 Depth well drilled 1804 Present depth 1804
3. Casing: 5 1/2 inch to 1640' feet.
4. Perforation: No. of shots _____ from _____ to _____
5. Acid: Gellions _____ from _____ to _____ Date _____
6. Initial production: Barrels oil _____ Barrels water _____
7. Present production: Barrels oil _____ Barrels water _____
8. Place where sample was obtained by bailor
9. Date of completion of well Jan. 11, 1962
10. Properties of reaction in percent:
Primary salinity _____ Primary alkalinity _____
Secondary salinity _____ Secondary alkalinity _____
 $r SO_4$ in $(r SO_4 + r Cl)$ _____; $(r CO_3 + r HCO_3) \div SO_4$ _____

11. Constituents	Ppm.	12. Reacting values	Ppm.	%	13. Hypothet. combination	Ppm.
NH ₄	_____	Alkalies:	_____	_____	KNO ₃	_____
Na	_____	r Na	_____	_____	KCl	_____
K	_____	r K	_____	_____	K ₂ SO ₄	_____
Ca	_____	r NH ₄	_____	_____	K ₂ CO ₃	_____
Mg	_____	Alk. earths:	_____	_____	NaNO ₃	_____
SiO ₂	_____	r Ca	_____	_____	NaCl	_____
Non-vol.	_____	r Mg	_____	_____	Na ₂ SO ₄	_____
Fe	_____	Total	_____	_____	Na ₂ CO ₃	_____
Al ₂ O ₃	_____	Strong acids:	_____	_____	NH ₄ NO ₃	_____
Mn	_____	r SO ₄	_____	_____	NH ₄ Cl	_____
SO ₄	_____	r Cl	_____	_____	(NH ₄) ₂ SO ₄	_____
Cl	<u>10,640</u>	r NO ₃	_____	_____	(NH ₄) ₂ CO ₃	_____
NO ₃	_____	Weak acids:	_____	_____	Mg(NO ₃) ₂	_____
CO ₂	_____	r CO ₂	_____	_____	MgCl ₂	_____
HCO ₃	_____	r HCO ₃	_____	_____	MgSO ₄	_____
Free CO ₂	_____	Total	_____	_____	MgCO ₃	_____
H ₂ S	_____	14. pH	_____	_____	CaCl ₂	_____
Fe ₂ O ₃ (unfiltered)	_____		_____	_____	CaSO ₄	_____
Total solids	<u>19,606</u>		_____	_____	CaCO ₃	_____

15. Condition of sample:
(a) Color Colorless
(b) Odor Very slight H₂S - salty
(c) Turbidity slight
(d) Oil present? no
(e) Necessary to filter? Yes
(f) Container Mason Jar

Al₂O₃ _____
MnO _____
Non-vol. _____
Total _____

Date of report Feb. 9, 1962

O. W. Rees
Analytical Division